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Oldřich UČEŇ[*], Pavel KUNZL[**], Jan BLATA[***], Tomáš KUBÍN[****]

TRENDS IN CAR DESIGN WITH REFERENCE TO PEDESTRIANS SAFETY

TRENDY V KONSTRUKCI AUTOMOBILŮ S OHLEDEM NA BEZPEČNOST CHODCŮ

Abstract

The new methodology to vehicle evaluation valid since 2009 determines four thematic categories: protection of travelling adults and children, pedestrians and assistance systems. During the procedure of vehicle design the single parts are tested individually and the full test follows after the vehicle has been completed.

Abstrakt

Nová metodika hodnocení vozidel platná od roku 2009 stanovuje čtyři tematické kategorie. Jsou to ochrana dospělých cestujících, ochrana dětí, ochrana chodců a asistenční systémy. Při vývoji komponentů automobilu se jednotlivé části testují odděleně a kompletní test následuje v okamžiku, kdy je automobil vyvinut.

1 INTRODUCTION

During several years the passive safety of vehicles was tested according to relatively stable methodology and according to the evaluation a particular vehicle was awarded by so-called stars. The development in automobile factories has taken a step forward within that time and vehicles have become for their staff safer thanks to a stiffer car body or improvement of retaining and preventive systems. To sum up, vehicles have become safer for their staff but the environment has been forgotten a little.

The new methodology tries to be more complex in the evaluation of vehicles safety. Since 2009 the organization responsible for evaluation of vehicles safety (Euro NCAP) has been testing vehicles according to this methodology.

2 EVALUATING CATEGORIES [1]

The category of assistance systems which interferes into the general evaluation has become a new category. Its main aim is to exert pressure on vehicles manufacturers to equip their products with systems whose challenge is to avoid crashes and their consequences. The category of pedestrian protection can be marked as renewed. The category was tested earlier however separately and it did not influence the general evaluation of vehicles safety and also assignation of the numbers of starts. The category of pedestrian protection originated on the grounds of the EEVC organization WG17 group work after it was found that pedestrians and other unprotected persons (cyclists, motorcyclists)

[*] Ing., Ph.D., VŠB – Technical University of Ostrava, Faculty of Mechanical Engineering, Department of Production Machines and Design, 17. listopadu 15, 708 33 Ostrava - Poruba, tel. (+420) 59 732 4274, e-mail oldrich.ucen@vsb.cz

[**] Ing., Visteon – Autopal, s.r.o., Lužická 14, 741 01 Nový Jičín, tel. (+420) 55 678 0724, e-mail pkunzl@visteon.com

[***] Ing., VŠB – Technical University of Ostrava, Faculty of Mechanical Engineering, Department of Production Machines and Design, 17. listopadu 15, 708 33 Ostrava - Poruba, tel. (+420) 59 732 4380, e-mail jan.blata@vsb.cz

[****] Ing., VŠB – Technical University of Ostrava, Faculty of Mechanical Engineering, Department of Production Machines and Design, 17. listopadu 15, 708 33 Ostrava - Poruba, tel. (+420) 59 732 4579, e-mail tomas.kubin@vsb.cz

form nearly one third of all killed participants of public traffic. The European Parliament and the Council 2003/102/ES issued a new legislation concerning the obligation of protection of pedestrians and other unprotected participants of public traffic against a crash and also in case of a crash with a motor vehicle. Afterwards it was found that it is not possible to fully carry out all the requirements of this legislation. Therefore it was replaced by an European Parliament and Council ES 78/2009 regulation concerning the approval of motor vehicles types with regard to the protection of pedestrians and other unprotected participants of public traffic where some of the requirements where made less strict. The organization Euro NCAP drew inspiration from the legislation for a point and star evaluation concerning pedestrian safety. It is important to stress that in some details in methodology Euro NCAP can differ from the legislation and the results cannot influence the vehicle homologation. They have only informative and marketing sides which serve customers to have more information before a purchase of a new car.

All categories have a maximum number of points. The strength of each category relatively shows the importance of the category for the vehicle safety. The total evaluation (the mark) is expressed by a weighted average made from all for categories. According to a given key the total mark is then transformed to a number of stars. In case some evaluation does not reach in a particular category the minimum value for given number of stars the total evaluation can be reduced. This fact should avoid a higher evaluation in case that a vehicle reaches in one category distinctively lower evaluation than in other ones.

The protection of adult's passengers – it is possible to obtain maximum 36 points. The points can be reached in four categories: frontal impact into a deformed barrier – 16 points, side impact – 8 points, pole impact test – 8 points (this test can be realized only by head airbags), the fourth category is the evaluation of a neck spine injury risk – 4 points (this evaluation consists of the evaluation of the seat geometry and of dynamic tests).

The protection of babies – it is possible to obtain maximum 49 points. What is evaluated here: dynamic tests with crash test dummies of children aged 1,5 to 3 years placed in retaining systems in a frontal and side impact – 12 points (for each variant), retaining systems – 4 points (for each variant), fixation in the vehicle – 2 points (for each variant). Furthermore the vehicle is evaluated from the following points of view – the marked switch-off of the airbag, the presence of three-point seat belts, the suitability for universal child seat, the presence of ISOFIX fixture and so on – 13 points.

The protection of pedestrians – it is possible to obtain maximum 36 points. The points can be reached in four categories: baby head impact (impactor weighted 2,5 kg) and adult head impact (impactor weighted 4,8 kg) – 24 points in total, injury risk of lower extremities by a bumper – 6 points, injury risk by a bonnet and bumper – 6 points.

Assistance systems – it is possible to obtain maximum 7 points. It is a new category. The points can be reached in three categories: presence of unfasten seat belt reminder – 3 points, presence of stabilizing system – 3 points, presence of an equipment limiting a drive with set speed (it can warn drivers or directly actively intervene) – 1 point. If a car wants to obtain points in this category, at least 85% vehicles sold on the European market have to be equipped by this equipment. The requirement will be gradually increased to 100% (in 2012).

Tab. 1 Needed percentage of maximum point evaluation for stars obtaining in 2009

The number of stars (for the year 2009)	The adult protection	The baby protection	The pedes-trian protec-tion	Assistance systems	Weighted average in total
★★★★★	75 %	70 %	25 %	60 %	70 %
★★★★	60 %	55 %	15 %	40 %	55 %
★★★	30 %	30 %	10 %	25 %	45 %
★★	25 %	25 %	5 %	15 %	35 %
★	15 %	15 %	0 %	5 %	20 %

Tab. 2 Needed percentage of maximum point evaluation for stars obtaining in from 2010

The number of stars (from the year 2010)	The adult protection	The baby protection	The pedes-trian protec-tion	Assistance systems	Weighted average in total
★★★★★	80 %	75 %	40 %	60 %	75 %
★★★★	65 %	60%	25 %	40 %	60 %
★★★	35 %	30 %	15 %	25 %	50 %
★★	30 %	25 %	10 %	15 %	35 %
★	20 %	15 %	5 %	5 %	25 %

Tab. 3 Needed percentage of maximum point evaluation for star obtaining from 2012

The number of stars (from the year 2012)	The adult protection	The baby protection	The pedes-trian protec-tion	Assistance systems	Weighted average in total
★★★★★	80 %	75 %	60 %	60 %	80 %
★★★★	70 %	60 %	50 %	40 %	70 %
★★★	40 %	30 %	25 %	25 %	60 %
★★	30 %	25 %	15 %	15 %	55 %
★	20 %	15 %	10 %	5 %	45 %

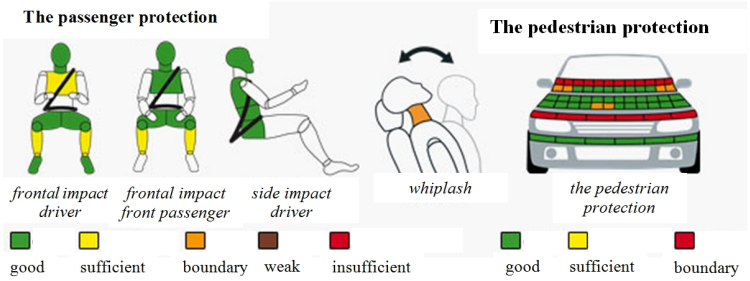

Fig. 1 The results of BMW X1 test according to Euro NCAP [3]

The general evaluation comes from the weighted average from the categories above. The methodology judges each category according to its importance. This importance will gradually change until the year 2012. In practice it means that if a vehicle in 2009 obtained for the pedestrian protection 5 stars, from 2012 will in this category obtain at equal conditions only 3 stars. The percentages in the tables are shown according to particular years in each category for reaching a particular number of stars. The sample of test is shown in the figure 1.

3 THE DEVELOPMENT OF VEHICLE COMPONENTS

It is obvious that automobile factories and furthermore component suppliers had to react on the change in regulations.

For the verification of MKP calculation at headlights designing a testing machine for crash tests of headlights was developed together with the cooperation of Visteon-Autopal, Ltd company. The thigh impact can be tested on this machine – upper leg. The following test is so-called insurance impact. During testing we measure the forces in fastening points in a headlight and the speed of impactor,[4]. The whole crash test is recorded thanks to high-speed camera so that it could be easier to evaluate the deformations during testing. In the figure 2 the headlight is fastened on a tool which tries to imitate the fastening in a vehicle from the building point of view. The headlight after the crash test is shown in the figure 3.

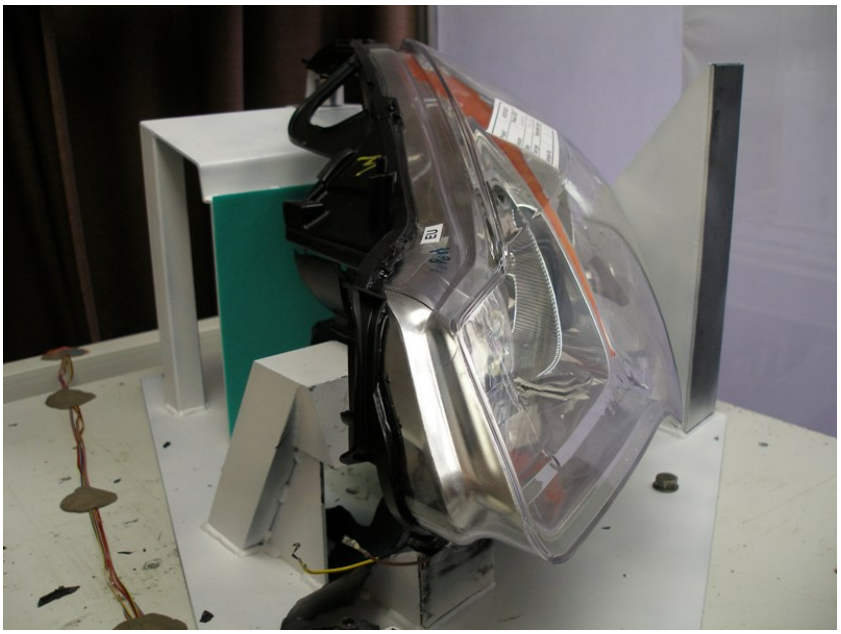

Fig.2 The headlight placed on a tool

The first headlight which was tested on the machine shown above from the beginning of the development to the last version was the headlight of Citroen DS3 and new versions of Citroen C3, figure 4. The tests helped constructional changes of headlight parts as well as material changes.

Fig.3 The headlight after the test

Fig.4 Citroën C3 [5]

4 CONCLUSIONS

As it was said in the article the regulations which new vehicles have to reach are being made stricter. The positive side is that the vehicle safety started to be solved more complex and not as it was for a long time before when solely the staff safety was solved. Of course, the development follows the line 3D design – MKP calculation which is supported by experimental tests.

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